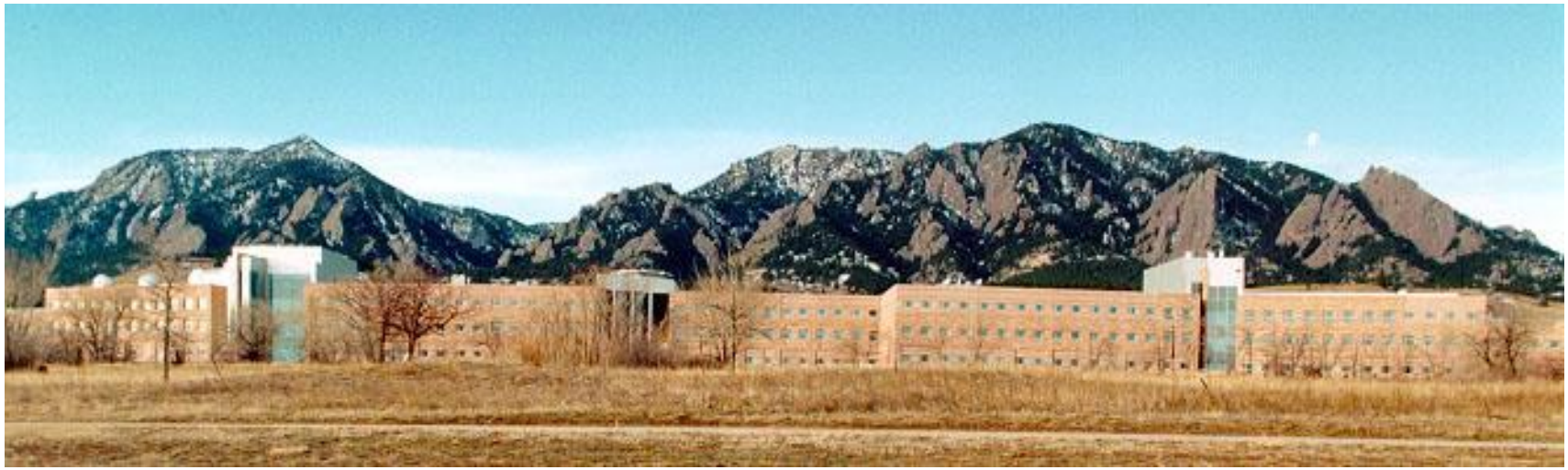

Quarterly Divisional Review

11 Feb 2009

1QFY09

Dr. William F. Denig, Chief

Solar & Terrestrial Physics Division

NOAA/NESDIS/NGDC

303 497-6323

William.Denig@noaa.gov

OUTLINE

Solar & Terrestrial Physics Division

STP Program Overview

Milestones & Performance Measures

Accomplishments

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STP Division Overview
Personnel

Solar & Terrestrial Physics Division
William Denig/F, Chief
Janet Brown/F, Secretary
Karen Horan/F, Physical Science Tech
Craig Clark/F, Scientific Data Tech

Space Environment Group (SEG)

Eric Kihn/F, Team Lead
- Terry Bullett/C
- Ray Conkright/C
- Ed Erwin/F
- Rob Redmon/F
- Herb Sauer/G
- Dan Wilkinson/F
- Jim Manley/C
- Helen Coffey/G

Earth Observation Group (EOG)

Chris Elvidge/F, Team Lead
- Kim Baugh/C
- Ben Tuttle/C
- Tilottama Ghosh/C
- David Ziskin/C

Earth Geophysics Group (EGG)

Vacant/F, Team Lead
- Patrick Alken/C
- Rob Prentice/C
- Fran Coloma/C
- Justin Mabie/C
- Andrea Bilich/F, NGS
- Don Herzog/G

Key
F – Federal
C – CIRES/CIRA
S – Student
G – Guest Scientist

STP Division Overview
Personnel Changes

- **Gains**
  - None
- **Losses**
  - Erin Rowland – Returned to full-time student status
- **Vacancies**
  - SWPC Liaison – In process
  - Space Weather Modeler – Waiting to be posted @ CIRES PRA
  - Student Assistant – Web designer – Posted @ CIRES SA
  - NPOESS S/W Engineer – Initiating action @ CIRES PRA
  - SEG Solar Physicist – On hold
  - STP Real-time Data Manager – On hold
- **Inbound**
  - Matthew Niznik – Hollings Scholar (SEG) – University of Miami
  - Salman Naqvi – Hollings Scholar (EOG) – NJ Institute of Technology
- **Pending**
  - NGS – Interested in DSRC otherwise O.B.E.

STP Division Overview
Agreements – Status

STATUS

Scope	Team	Type	Partner	NOAA Legal	DOC Legal	NGDC Signed	Partner Signed	Start	End	Status	
DMSP Archive	SEG	MOA	DMSP	X	X	X	X	30-Mar-07	30-Sep-09	G	In place - nothing to report
SWx Climatology	SEG	MOU	AFCCC	X	X	X	X	27-May-04	01-Oct-14	G	In place - nothing to report
Ionospheric Data	SEG	MOU	AFWA	X	X	X	X	21-Aug-06	21-Aug-11	G	In place - nothing to report
Ionosonde Sites	SEG	MOU	USGS	X	X			*TBD*	*TBD*	Y	*In final review at legal*
NASIC	EOG	MOU	NASIC	X	X	X	X	09-Mar-06	01-Jan-11	G	In place - nothing to report
CORS Support	EGG	AGR	NGS	n/a	n/a	X	X	01-Oct-03	30-Sep-09	G	In place - nothing to report
Earth Imagery	EOG	MOU	NGA					*TBD*	*TBD*	Y	*On hold*
SEM-N - AFRL	SEG	MOA	AFRL					*TBD*	*TBD*	Y	*Initial Draft - Aggressive schedule*

Updated: 09 Feb 09

STP Division Overview
CDMP – Status

Dataset	Funded in FY08	Submitted - FY09	POC	Contractor ($K)	NGDC ($K)	% Expended
Heat capacity mapping mission (L44)	X	X	Elvidge	60.0	6.0	5.3%
DMSP film scanning (L3)	X	X	Elvidge	825.0	82.5	82.5%
DMSP P/L activiation messages (L41)	X	X	Elvidge	30.0	3.0	97.8%
Historical solar spectral data (L16)	X	X	Denig/Coffey	65.0	6.5	62.6%
Cosmic rays - Forbush archives (L42)	X	X	Denig/Coffey	85.0	8.5	56.5%
Historical solar observations (L18)	X	X	Horan	90.0	9.0	68.3%
Historical ionosonde records (L7)	X	X	Redmon	75.0	7.5	44.7%

Updated: 31 Dec 08

STP Division Overview
Submitted Proposals ($841,000)

Group	Proposal	PI	Program	Agency	Status	FY09	Years	Total
EOG	Rapid Assessment of Human Activities for Priority Seascape Designation in the Coral Triangle Region	Elvidge	Coral Reef	NOAA	Submitted	$55,000	2	$90,000
EOG	Surveillance and reporting on fishing boat, fishing platforms and fish attracting devices (FADs) in the CTI region	Elvidge	Coral Reef	NOAA	Submitted	$85,000	4	$340,000
EOG	Atlas of Coral Reef Bleaching for Priority Seascape Designation in the Coral Triangle Region	Elvidge	Coral Reef	NOAA	Submitted	$192,000	2	$384,000
EOG	Delineation of Power Outage Extents from the International Space Station	Elvidge	Earth Sciences	NASA	In review	$180,000	3	$381,000
EOG	Estimation of Gas Flaring Volumes Based on MODIS Fire Detection Data	Elvidge	Earth Sciences	NASA	In review	$110,000	1	$110,000
EGG	Fundamental Studies of Equatorial Ionospheric Electrodynamics Having Applications to Future DoD Space Weather Products	Maus	CNOFS	AFOSR	Submitted	$108,922	3	$341,692
SEG	Prototype Cloud Based Storage for Networked Computing	Kihn	HPCC	NOAA	Submitted	$65,000	1	$65,000
SEG	Portable Tiled Display VideoWall for Geospatial Visualization	Kihn	HPCC	NOAA	Submitted	$46,000	1	$46,000

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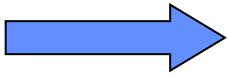
Solar & Terrestrial Physics Division

STP Program Overview



Milestones & Performance Measures

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Milestones & Performance Measures

FY09 Milestones

	PPBES Program	STP FY09 Milestones (Proposed)	Status	Planned Completion Date	Actual Completion Date	Responsible Person
AOP →	Space Weather	Complete data rescue of available synoptic solar drawings from the Wendelstein Solar Observatory for the period 1946-1987.	C	(Q1) 12/30/2008		Horan / Fischman
AOP →	Marine Transportation Systems	Develop a generalized methodology for the detection of coral reef bleaching from satellite-based imagery.	C	(Q1) 12/30/2008		Ziskin
	Marine Transportation Systems	Initiate reprocessing of Defense Meteorological Satellite Program (DMSP) imagery for the period 1992-2005 using new software procedures providing archival product consistency.	G	(Q2) 3/31/2009		Erwin
	Space Weather	Implement new visualization product for energetic particle data from the POES Space Environment Monitor (SEM) that will provide a planetary perspective for this environment. (SWP)	G	(Q2) 3/31/2009		Wilkinson
AOP →	Space Weather	Release version 5 of the NOAA Space Physics Interactive Data Resource (SPIDR) utility including improved database access and metadata editing capabilities. (SWP)	G	(Q2) 3/31/2009		Kihn
	Space Weather	Develop scripts to convert raw magnetometer data into WDC format and make those scripts available to the public to increase the useable of the NOAA data products.	G	(Q3) 6/30/2009		Mabie
AOP →	Marine Transportation Systems	Estimate national and global gas flaring levels for 2007 using Defense Meteorological Satellite Program (DMSP) nighttime lights imagery.	G	(Q3) 6/30/2009		Elvidge
	Space Weather	Provide functional requirements and mapping to the CLASS Developmental Team for the Simple NOAA Archive Access Portal (SNAAP) API.	G	(Q3) 6/30/2009		Kihn
	Marine Transportation Systems	Complete development of a radiance calibrated global nighttime lights product set for Defense Meteorological Satellite Program (DMSP) spanning 1996-2006.	G	(Q4) 9/30/2009		Elvidge
AOP →	Space Weather	Acquire and archive historical GOES 8-12 “raw” data files currently maintained by the NWS Space Weather Prediction Center (SWPC) on CD. (SWP)	G	(Q4) 9/30/2009		Wilkinson
	Space Weather	Release version 2 of the MIRRION ionospheric sounding data collection, processing, and dissemination system for increased station capabilities and improved reliability.	G	(Q4) 9/30/2009		Redmon

AOP → AOP milestone

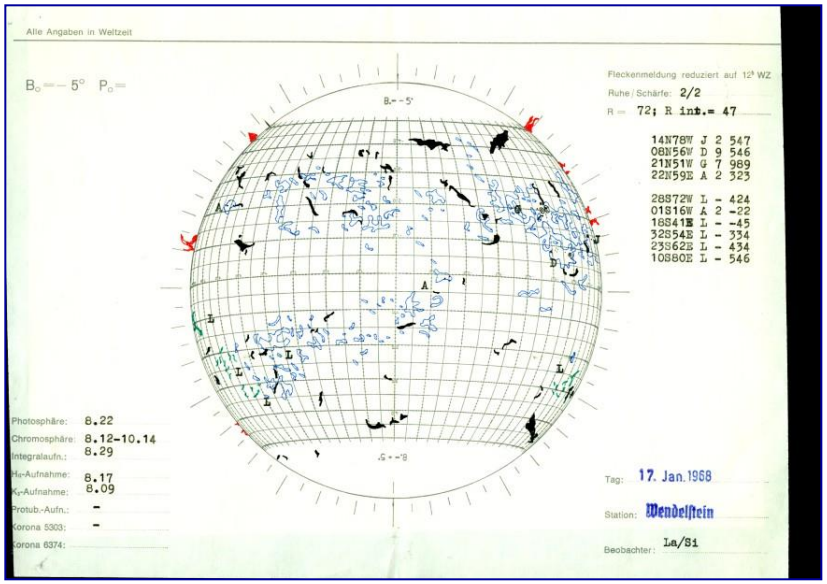
C Complete

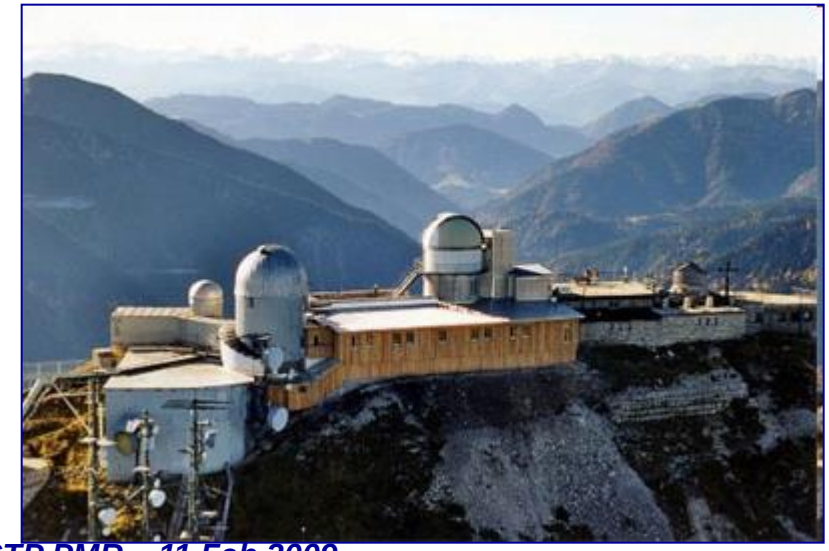
G On-track

Y Watch Item

R Issue

Milestone (AOP)
Data Rescue of Historical Solar Drawings





Milestone: Complete data rescue of available synoptic solar drawings from the Wendelstein Solar Observatory for the period 1946-1987.

Background: This unique set of composite drawings provide an historical record of numerous solar features (sunspots, prominences, and filaments) over several solar cycles which can be compared to current, satellite-based solar observations. These drawings have been digitally preserved through the Climate Data Modernization Program (CDMP) and are now being made available to the scientific community.

Completion Date:

Planned	(FY08-1Q)	31Dec08
Actual	(FY08-1Q)	31Dec08

Significance: This effort contributes to the recognition of NGDC's role as a world authority in historical solar observations.

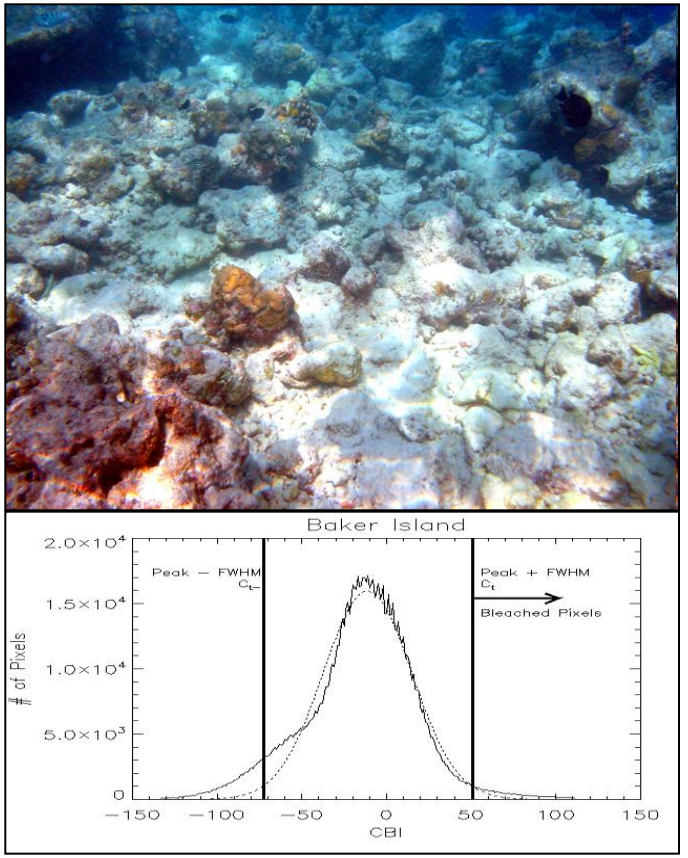
Milestone (AOP)
Coral Reef Bleaching

Milestone: Develop a generalized methodology for the detection of coral reef bleaching from satellite-based imagery.

Background: The nighttime lights group has created a Coral Bleaching Index (CBI) based on spectral earth observations. The CBI is a linear combination of weighted radiances from corrected blue (B), green (G), and red (R) light emissions:

$$CBI = 2*G + 1*B - 3*R$$

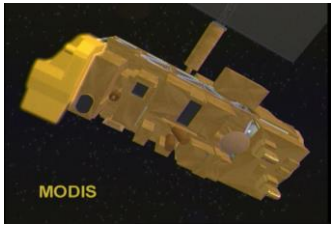
The figure on the right for Baker Island (Pacific atoll) illustrates how the CBI can be used to identify coral reefs at risk. Continuing efforts are still needed to validate the CBI and to automate the approach.

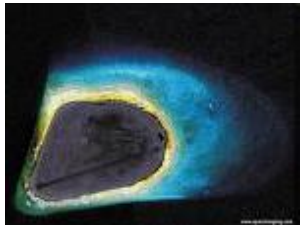


Completion Date:

Planned	(FY08-1Q)	31Dec08
Actual	(FY08-1Q)	31Dec08

Significance: Routine monitoring of CBI using remote sensing instruments, i.e. MODIS & VIIRS, can provide a continual assessment of coral reef health.





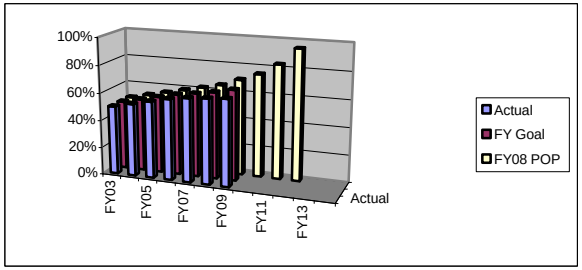
Milestones & Performance Measures

FY09 Performance Measures

Performance Measures

1 - Percentage of archived SWx data available to the public on-line

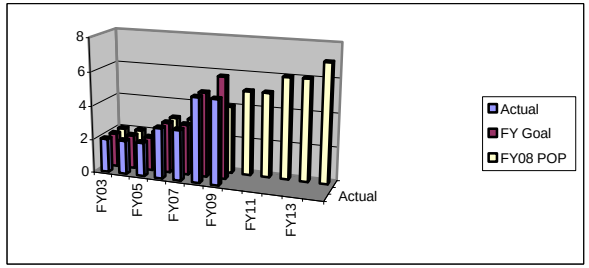
	Actual	FY Goal	FY08 POP
FY03	50%	50%	**50%**
FY04	53%	53%	53%
FY05	56%	56%	56%
FY06	59%	59%	59%
FY07	61%	61%	62%
FY08	62%	63%	**65%**
FY09	63%	66%	70%
FY10			75%
FY11			83%
FY12			**95%**
FY13			
FY14			



Current Month: *Preliminary*		
This Q Planned	Actual This Q/Total	FY09 Target
63%	63%	66%

2 - Improved retrospective products for understanding the space environment

	Actual	FY Goal	FY08 POP
FY03	2	2	**2**
FY04	2	2	2
FY05	2	2	2
FY06	3	3	3
FY07	3	3	3
FY08	5	5	**4**
FY09	5	6	4
FY10			5
FY11			5
FY12			**6**
FY13			6
FY14			7



Current Month: *Preminary*		
This Q Planned	Actual This Q/Total	FY09 Target
5	5	6

Updated: 2/03/09

The FY2008 Program Baseline Assessment (FY08 PBA) was released 08 Jun 2005

OUTLINE
Solar & Terrestrial Physics Division

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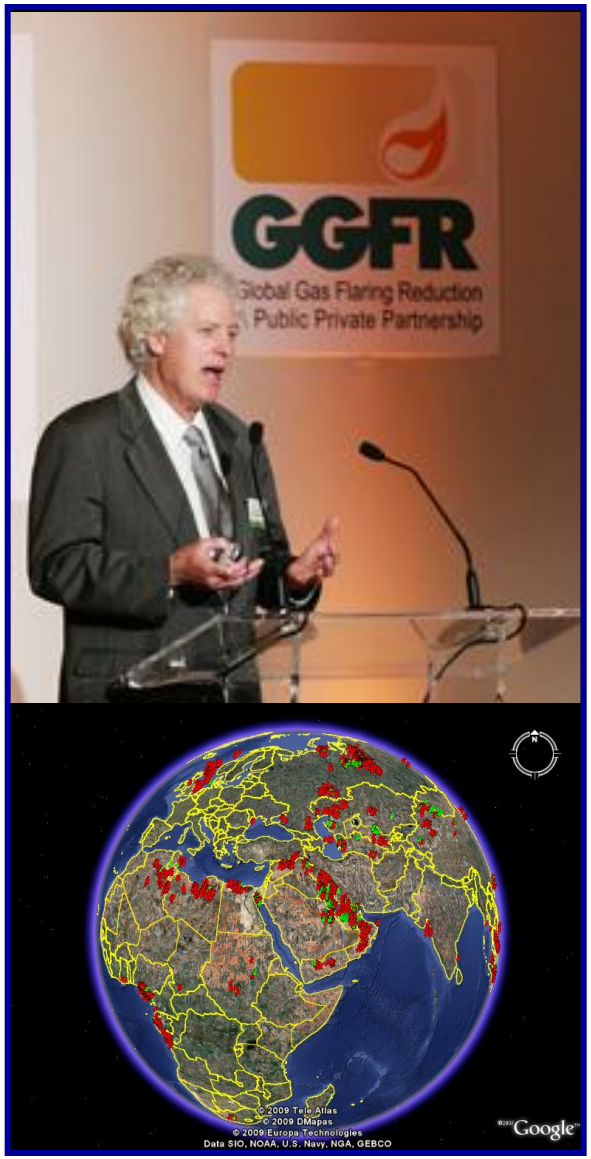
Accomplishment

NGDC Reported Drop in Global Gas Flaring



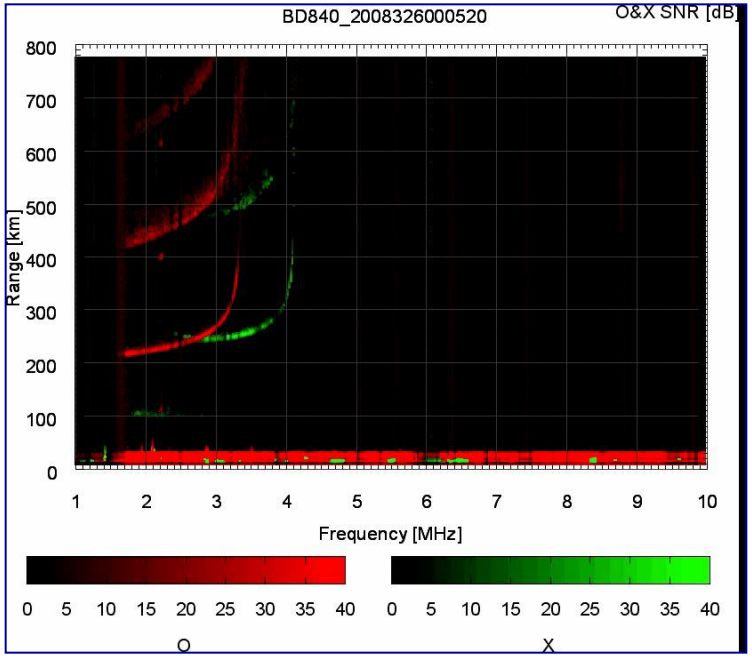
For the second year in a row the measured levels of global gas flaring in oil fields have decreased. These welcomed results were briefed by Dr Chris Elvidge at the World Bank Global Gas Flaring Reduction (GGFR) partnership steering committee meeting in Amsterdam, 03-04 Dec 2008. The measurements reported by NGDC were derived from nighttime lights imagery obtained from Defense Meteorological Satellite Program satellites.

NGDC's 2007 annual estimate for global gas flaring stands at 147 billion cubic meters of gas flared, releasing almost 400 million tons of carbon dioxide into the atmosphere. Trends towards reducing these level of global gas flaring are encouraging and indicate that ongoing initiatives for GGFR are working.

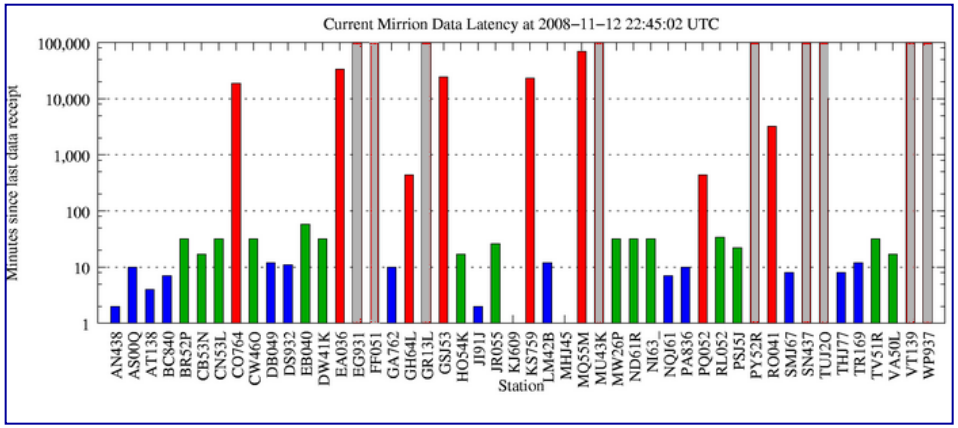
Accomplishment
NGDC Tests New Ionospheric Sounder

VIPIR – Vertical Incidence Pulsed Ionospheric Radar

- New ionospheric sounder based on engineering designs pioneered within NOAA
- Developed under a USAF Small Business Innovative Research (SBIR) contract
- Offers improved ionospheric characterization using less emitted power
- Installed at NOAA/Boulder – other units installed at Wallops and in South America
- Data to be included into NGDC's Mirrion real-time ionosonde collection system



Swept frequency radiowave echos from the ionosphere above Boulder.

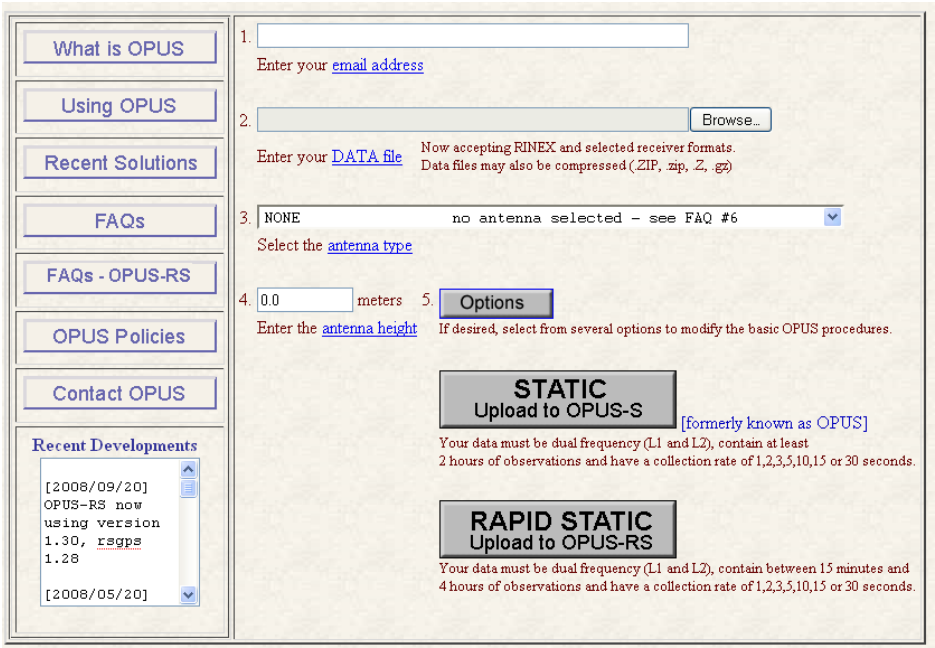


Mirrion station status chart

Accomplishment
OPUS Now Running at CORS West

Online Positioning User Service (OPUS) beta installation at CORS-West

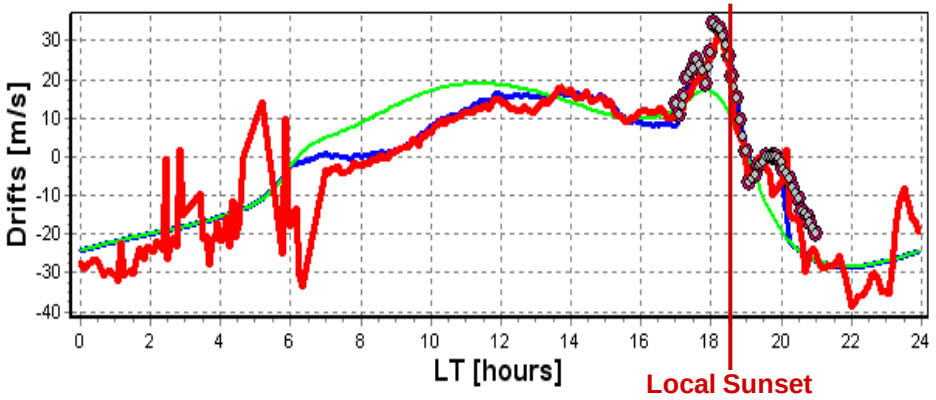
- **Two flavors – OPUS-S & OPUS-RS:**
  - OPUS-S (static) what was called OPUS – ~2 hours of data needed
  - OPUS-RS (rapid static) – ~15 minutes of data – 65% increase in number of users compared to last year.
  - User uploads their GPS receiver via the web – NGS computes a coordinate from the data and e-mails this result back to the user



- Status:
  - OPUS-S & OPUS-RS services have been installed at CORS-West
  - Services is being beta tested and are not yet publically available
  - Internal user access: http://alt.ngs.noaa.gov/OPUS-Boulder/

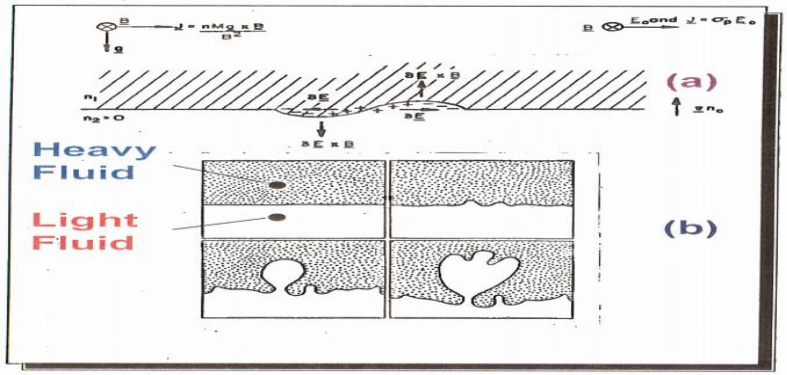
Accomplishment
FIRST

Forecasting Ionospheric Real-time Scintillation Tool (FIRST)



As the height of the ionosphere increases, so too does the recombination time leading to an unstable condition of a heavy gas atop a lighter gas. Radio-wave scintillation is caused by the Rayleigh-Taylor instability as the system attempts to shed available free energy.

Daytime thermospheric heating causes the ionosphere F-layer to rise. A plot of the afternoon ionosonde-inferred V_{EXB} vertical drift speeds is shown.



Jicamarca Scintillation Forecast (FIRST):

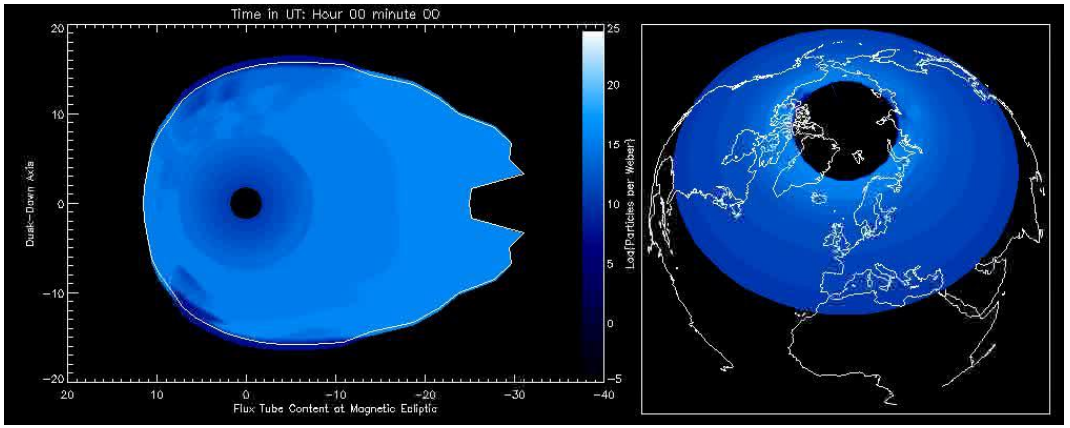
h'F time history (19:30LT previous day):

DOY (UT)	35	34	33	32	31	30	29
19:30LT	255.0	247.0	245.0	242.5	237.5	257.0	260.0

A scintillation forecast tool has been developed for Jicamarca and Kwajalein using the F10.7 normalized parameters:

[290 km, ∞]	Scintillation Likely
[255 km, 290 km]	Scintillation Possible
[0 km, 255 km]	Scintillation Unlikely

Accomplishment
Space Environmental Assessment - AFSPC



The NGDC Space Weather Analysis (SWA) effort provides a data-driven capability to assess the near-earth space environment using coupled assimilative models of the ionosphere and the inner magnetosphere. Recently, the Air Force Space Command (AFSPC) approached NGDC requesting help in assessing space environmental conditions for an extended period in 2008. Addressing this request required assembling the appropriate near-term datasets and tuning the environmental models for solar minimum conditions. Thanks to the herculean efforts of **Justin Mabie** a space environmental assessment was provided to AFSPC for their consideration and use.

AMIE – Assimilative Model of Ionospheric Electrodynamics

SIMM – Simple Inner Magnetosphere Model

OUTLINE

Solar & Terrestrial Physics Division

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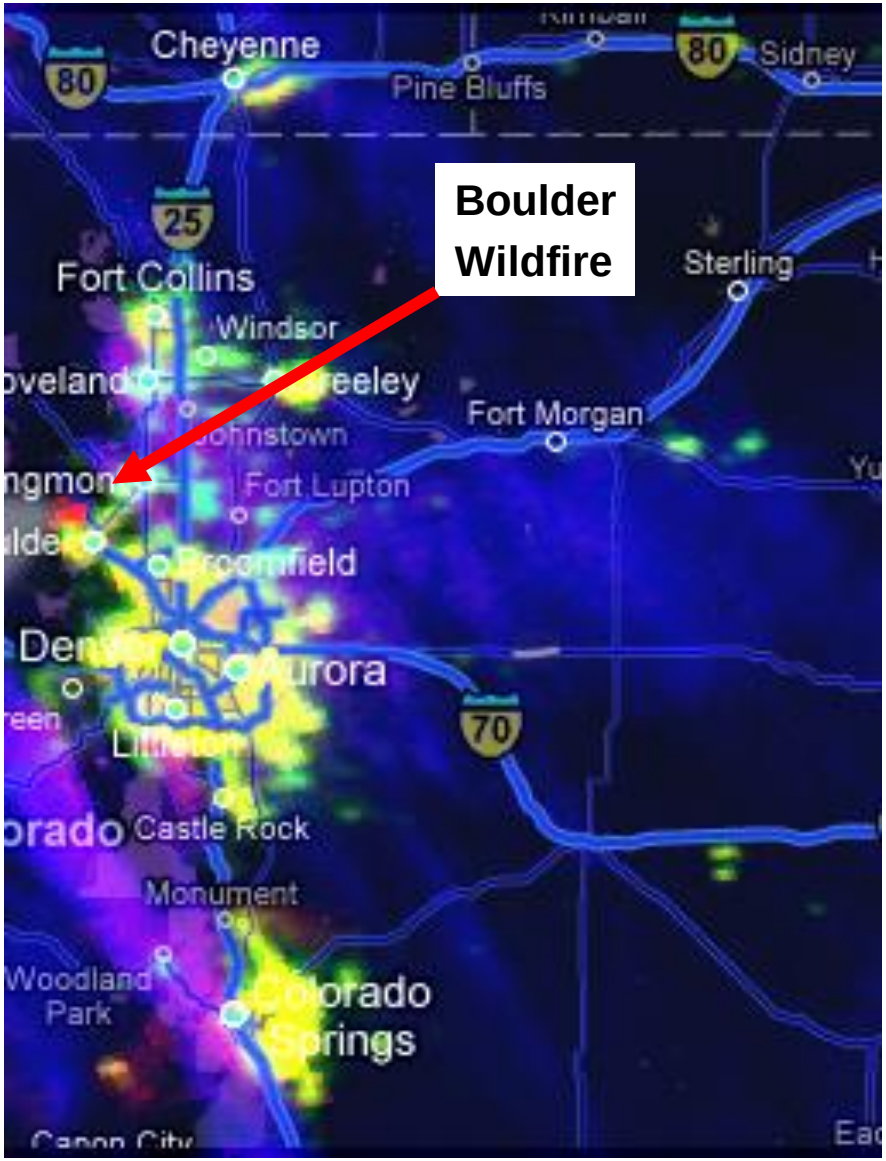
Special Interest Item
Boulder Wildfire – 07 Jan 09

Boulder Wildfire Observer by DMSP

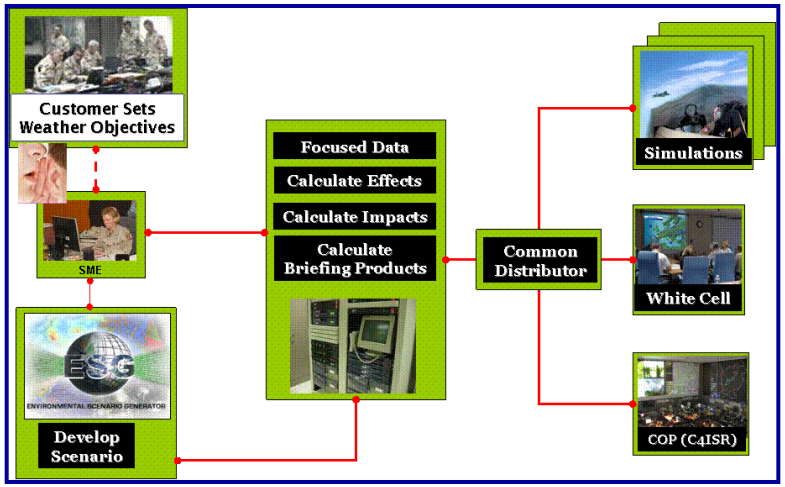
On 07 Jan 09 a wildfire driven by high winds scorched 3,000 acres in north Boulder and destroyed multiple homes and structures. The DMSP F16 satellite observed the wildfire in nighttime earth observations. The wildfire is seen in the adjacent composite image as the red artifact against the normal background lighting in and around Denver (yellow).

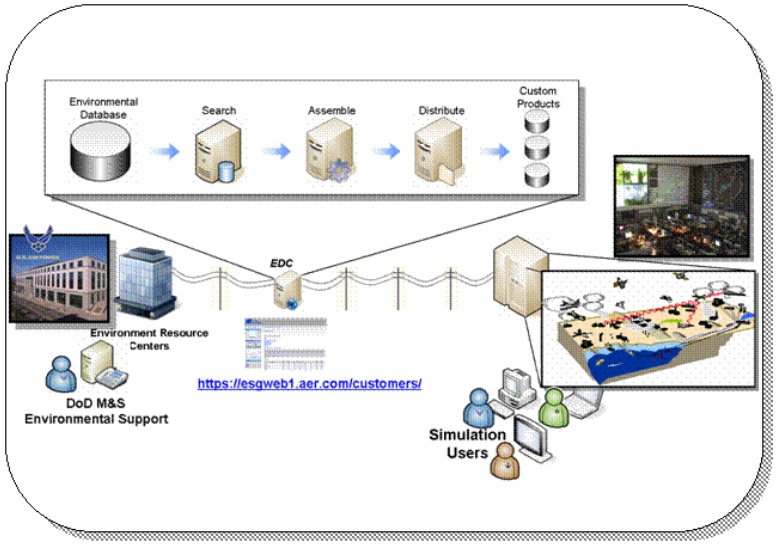


Special Interest Item
USAF Environmental Data Cube (EDC)

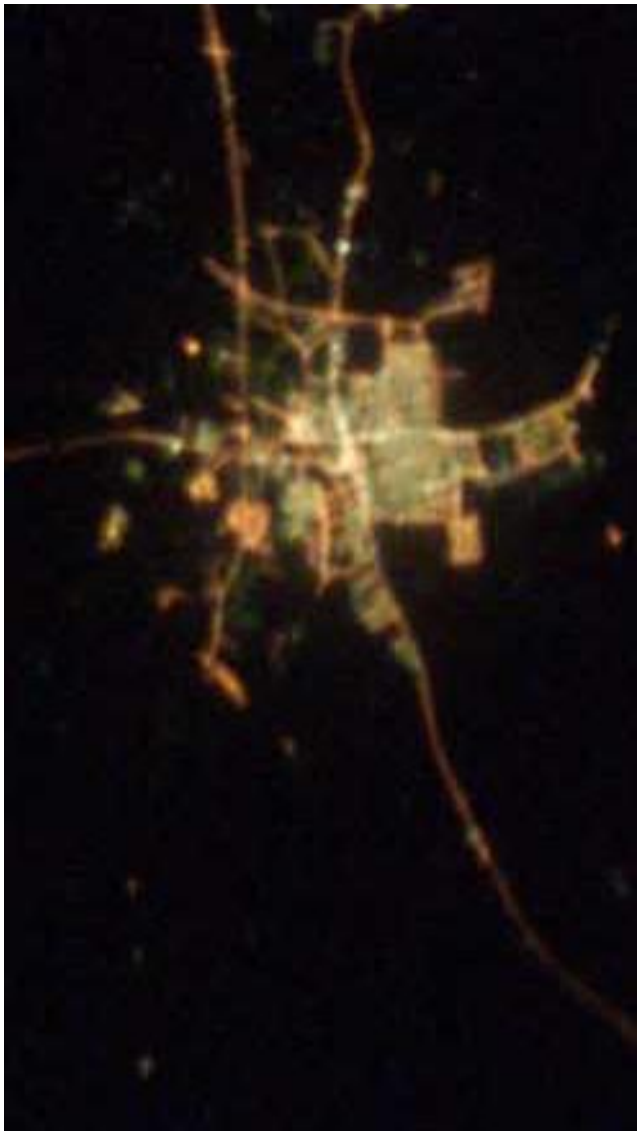
EDC is the link between Data Resource Centers and Modeling & Simulation

Representatives from the National Geophysical Data Center (NGDC) are working with the USAF's Environmental Data Cube Support System (EDCSS) team to integrate space weather data into DoD Modeling and Simulation (M&S). The basis of the interaction is NGDC's Space Environment Impacts System (SEIS) which provides similar impacts information to the civilian community. The EDCSS team working with NGDC has developed a plan to secure access to NOAA (and other) environmental databases through networked Application Programming Interfaces (APIs). NGDC is funded in FY09 to develop APIs to enable the EDC. NGDC's POC is Dr. Eric Kihn.





Special Interest Item
NightSat Mission Update



NIGHTSAT Instrument Design Study
NASA-GSFC November 17-21, 2008

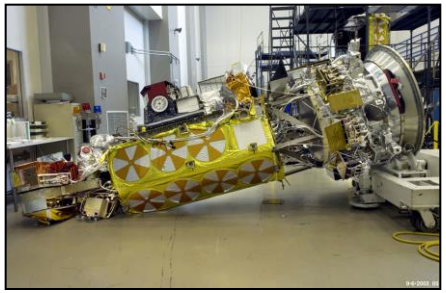
- Conducted by the GSFC Instrument Design Lab
- Customer was the Nightsat Science Team
- Low light imaging requirements met using a Time Delay and Integration (TDI) approach
- Primary features of the design:
  - ✓Three low light imaging bands at 50-meter resolution.
  - ✓Single thermal band at 500-meter resolution.
  - ✓Geometric accuracy +/- 50 meters.
- Cross track pointing capability
- Nightsat proposal planned for NASA Venture Class RFP. NASA participants include GSFC and Ames Research Center

Chris Elvidge participates as a member of the NightSat science team.

Special Interest Item
NOAA Satellite Launch Status

NOAA-19 Gets Off the Ground

NOAA-19 Launch
06 Feb 09 @ 10:22 UT



An Inauspicious Past

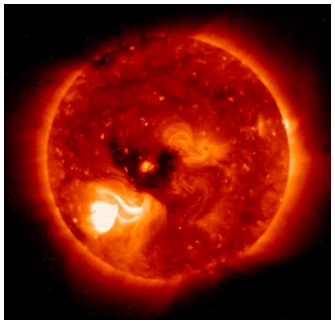
The final satellite in NOAA's POES series was launched from Vandenberg Air Force Base on February 6, 2009 at 2:22 AM PST. NOAA-N Prime was renamed NOAA-19 after achieving orbit. NOAA-19 carries a suite of instruments to measure the flux of energetic ions and electrons at the altitude of the satellite. *NGDC has archived POES space environmental data since 1978.*

GOES-O Set for Launch

The GOES-O is currently scheduled for an April 28, 2009 launch. Once on-orbit it will be renamed GOES-14 and placed into flight storage until ~2012.

The next satellite in the GOES series is GOES-P which is scheduled for launch in December 2009. *The GOES space weather archives at NGDC began in 1974 with data from SMS-1.*

Modifications have been made to the GOES-O SXI to protect it from damage from highly energetic flares as happened to GOES-13

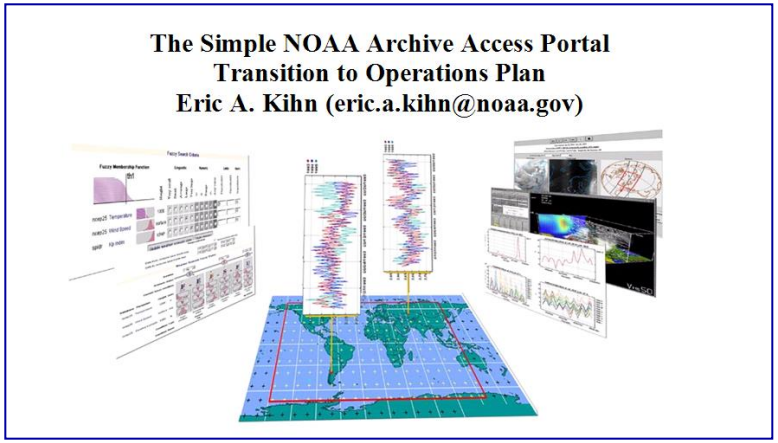


Special Interest Item
SNAAP / CLASS Status

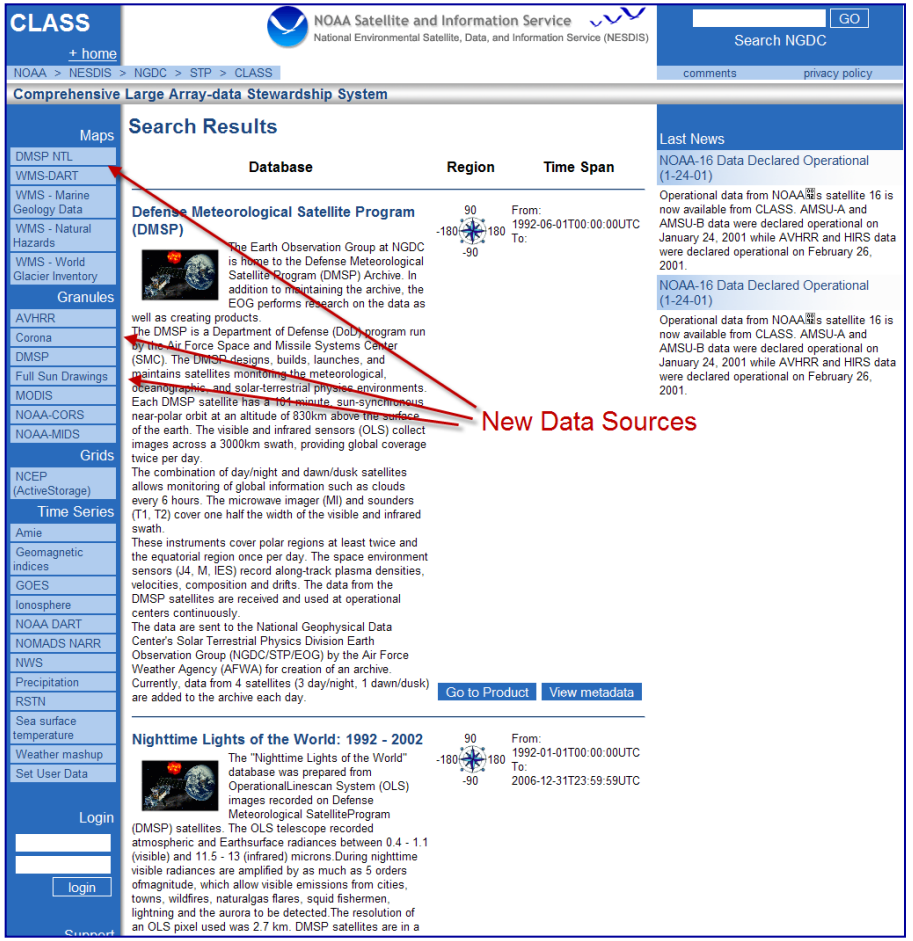
Simple NOAA Archive Access Portal

Recent Changes:

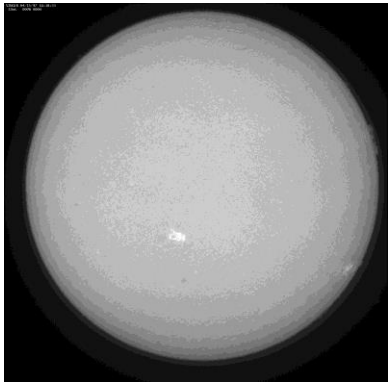
- New data sources and adapters added to SNAAP
- Inclusion of WMS & WCS [*new*]
- FTP access to solar imagery
- Transition documents delivered to CLASS development team
- Initial discussions for transition planning



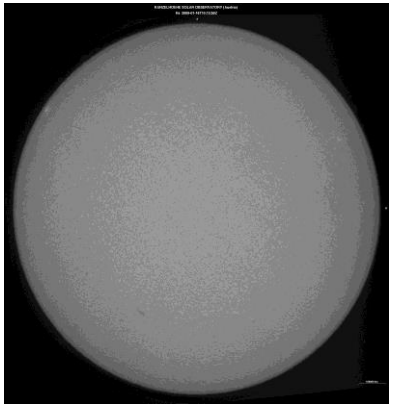
Comprehensive Large Array-data Stewardship System



Special Interest Item
Persistent Solar Quiet



April 1997

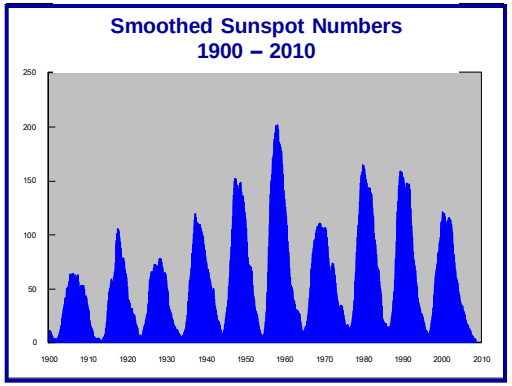


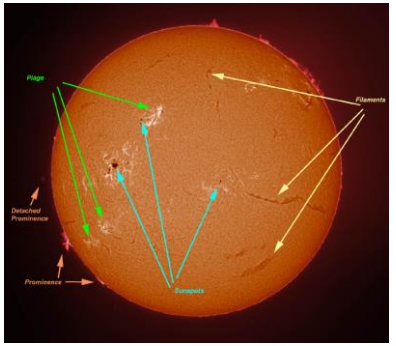
January 2009

Issue: The sun still remains remarkably quiet. Comparable solar images taken ~6 months after the nominal solar minimum (Jul 2008) continue to show a featureless sun for the current cycle. In the previous cycle (cycle 23) there were 170 spotless days ±6 months around solar minimum (10/1996). Cycle 24 now has 291 spotless days near solar minimum for an overall 71% increase.

Current understanding: Recent reports suggest that the current extended period of solar quiet has historical precedence. In fact, indications are that the last few solar cycles have been more volatile than the historical average.

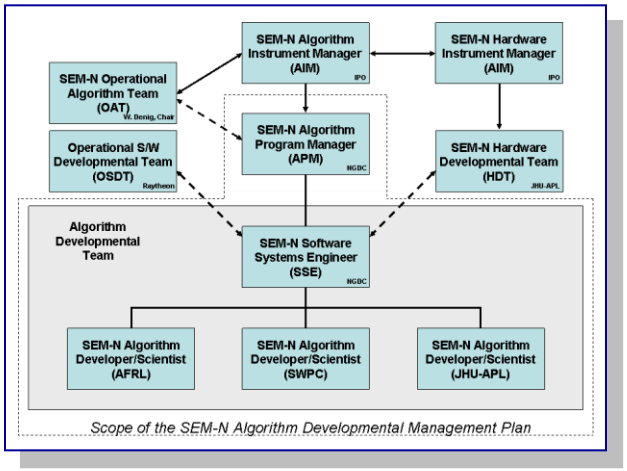
Note: NGDC archives provide the most complete and extensive record of the sun extending back many full solar cycles. This coming summer Hollings scholar **Matthew Niznik** (University of Miami) will examine the current solar cycle within the context of past cycles.





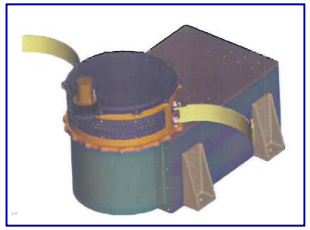
Solar Tutorial
"Active Sun"

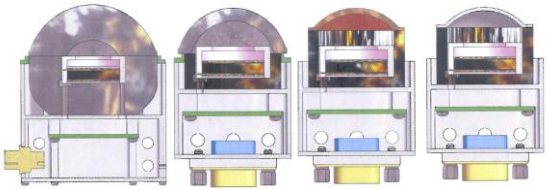
Special Interest Item
"Science-grade" SEM-N Algorithms



Scope of the SEM-N Algorithm Developmental Management Plan


Special Sensor J5 (SSJ5)


Energetic Particle Sensor (EPS)


High Energy Sensor (HES)

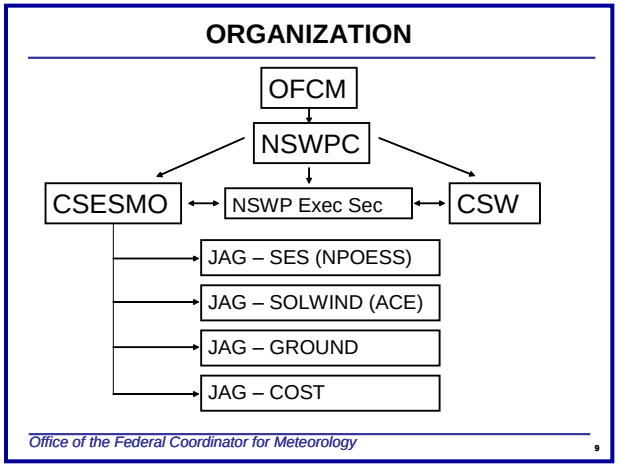
Space Environment Monitor for the National Polar-orbiting Operational Environmental Satellite System (NPOESS)

SEM-N

- NGDC team develops GFE SEM-N algorithms
- Draft program plan & developmental schedule submitted
- Awaiting funding approval for Authority To Proceed (ATP)
- Establishing NGDC teaming arrangements:
  - Draft MOA for AFRL participation
  - Draft request for SWPC support
  - Evaluating approaches for JHU/APL support
- Participated in SEM-N H/W System Requirements Review
- Determining accurate near-term funding and obligation requirements for NGDC and team members
- Determining process to provide funds to NGDC under fund transfer restrictions that are required for continuity of effort

Special Interest Item
OSTP Phase II Assessment

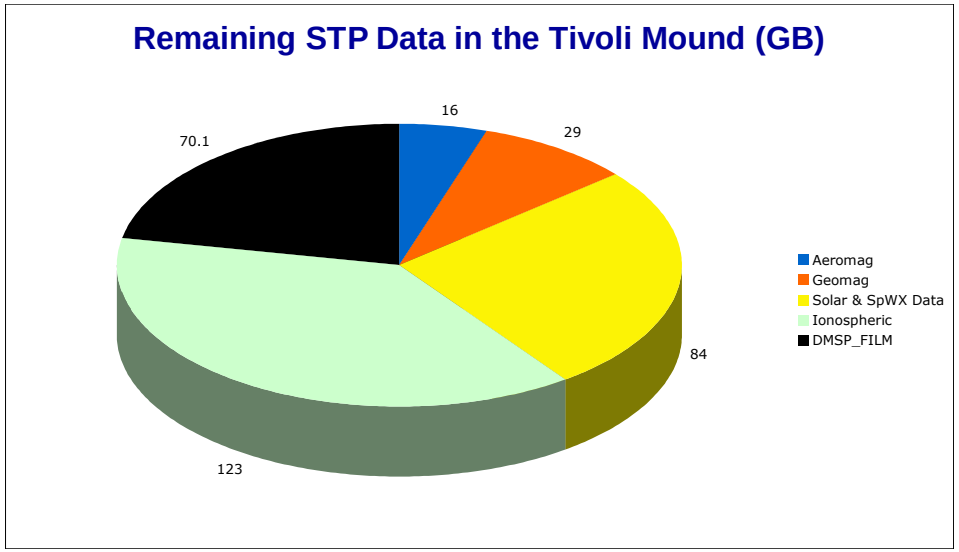
- OSTP requested the OFCM to conduct a phase II study to develop mitigation options for NPOESS and ACE
- Committee for Space Environment Sensor Mitigation Options (CSESMO) formed to coordinate study effort – co-chairs are Mary Kicza (NESDIS) and Col Shawn Barnes (AFSPC)
- Joint Action Groups formed to provide mitigation options and alternatives:
  - NSMO – NPOESS (W. Denig participant)
  - SOL – ACE (W. Denig listen in only)
  - SEG – Ground processing
  - SECAP – Cost and programs
- Initial OSTP deliverables are expected by 15 Jun 09 with final wrap-up by 01 Nov 09



Special Interest Item
Upcoming Meetings

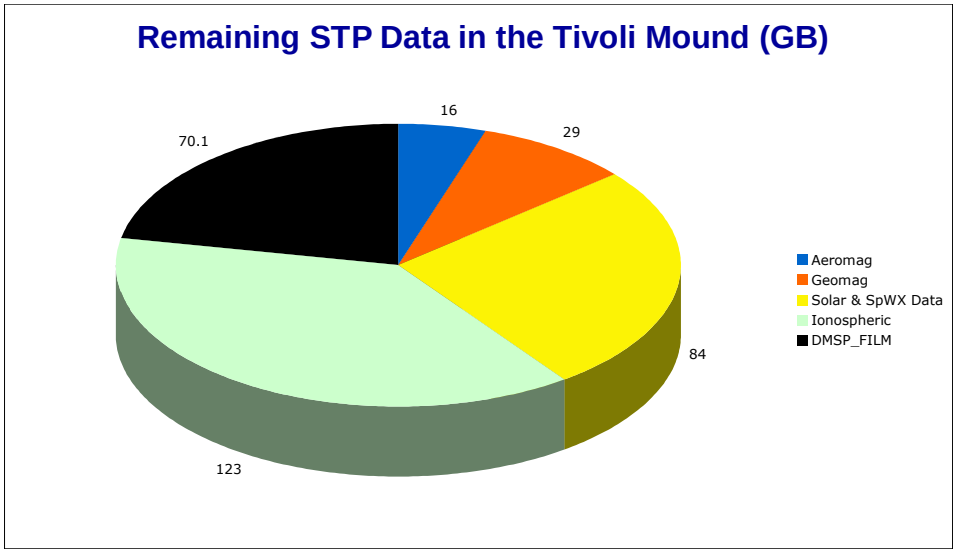
- ✓**ITM meeting, 10-12 Feb 09 (Los Angeles, CA)**
  - **Maus will attend for NGDC**
- ✓**Space Weather Workshop, 28 Apr-01 May 09 (Boulder CO)**
  - **Multiple attendees: Denig/Redmon/Kihn/Wilkinson, etc**
- ✓**IRI Technical Workshop, 04-06 May 09 (Colorado Springs, CO)**
  - **Redmon/Bullett/Manley**
- ✓**XII International Digisonde Forum, 11-15 May 09 (Lowell, MA)**
  - ***TBD***
- ✓**Space Weather Enterprise Forum, 19-20 May 09 (Washington, DC)**
  - **Bill Denig (probably) or Chris Fox**
- ✓**2009 Joint Urban Remote Sensing, 20-22 May 09 (Shanghai, China)**
  - **Chris Elvidge is chairing a session on nighttime lights**
- ✓**eGY Meeting, 03-06 Jun 09 (Pereslavl-Zalessky, Russia)**
  - **Eric Kihn – Invite letter from Alexi Gvishiani**
- ✓**IAGA, 23–30 Aug 09 (Sopron, Hungary)**
  - **Bill Denig (perhaps)**

Special Interest Item
Tivoli Mound



4QFY08

Total Size: 322 GB



1QFY09

Total Size: 322 GB (no change)

OUTLINE

Solar & Terrestrial Physics Division

STP Program Overview

Milestones & Performance Measures

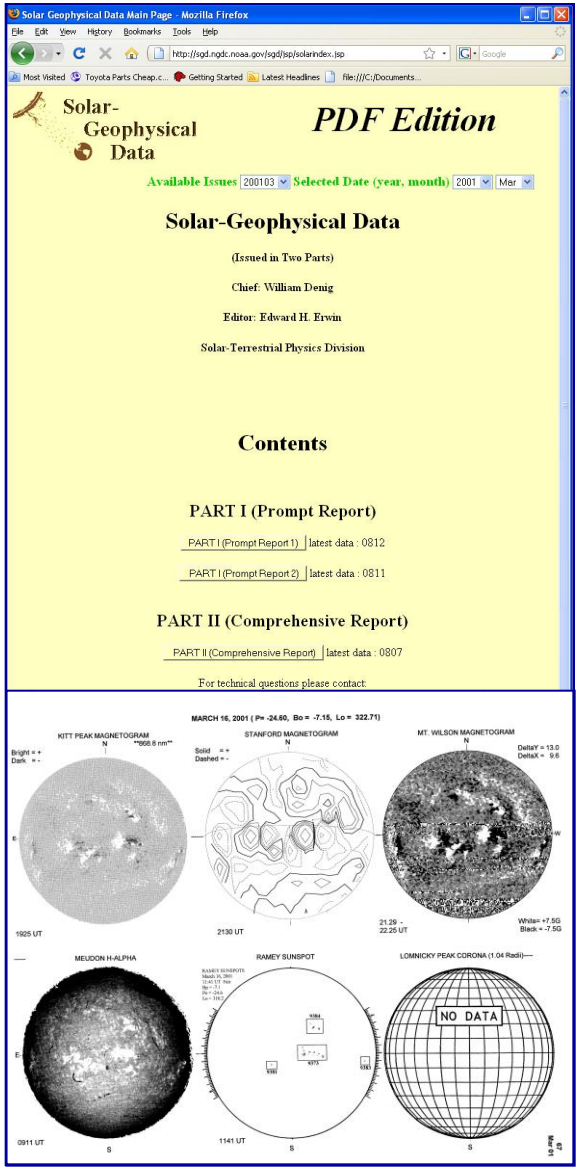
Accomplishments

Special Interest Items

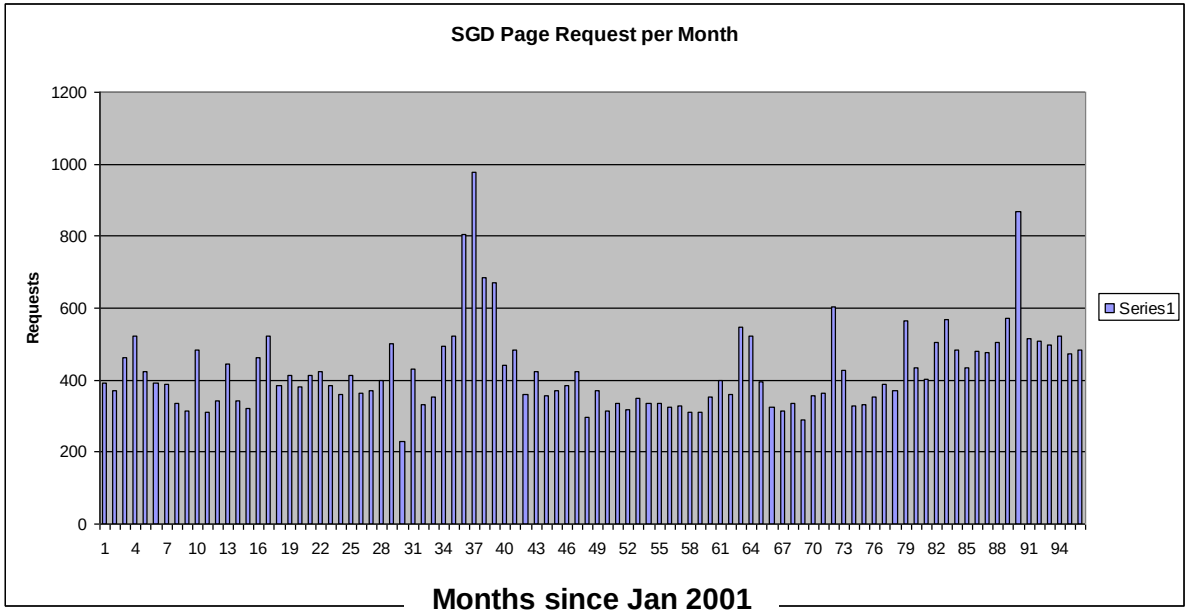
Issues & Summary

Issues & Summary

Solar Physicist – Solar-Geophysical Data



- **The anchor periodical for the solar data services group is the monthly SGD report (1957 – present)**
- **The SGD continues to be a popular publication providing a synoptic record of the sun & related geophysical data for the research & climate change communities**
- **Ed Erwin with Karen Horan's help is responsible for the SGD during the current solar quiet conditions**
- **There is no accession plan to maintain this capability once Ed retires and/or the sun becomes more active**



Issues & Summary

List of Issues from Prior Reviews

- **Continuity of solar data services (1QFY09) – active**
- **Refocus of NWS/SWPC Objectives (2QFY08) – plan in place**
- **NightSat Mission Concept (1QFY08) – active**
- **NGS Aerial Photography (1QFY08) – under discussion**
- **DMSP Data in CLASS (1QFY08) – active**

✓ *Federal Enterprise Ionosonde Network (4QFY07) – NLAI*

✓ *Station-Level Metadata (4QFY07) – NLAI*

✓ *Boulder-StarLight-Moscow (3QFY07) – NLAI*

✓ *Manpower Investments in CLASS TET (3QFY07) – NLAI*

✓ *CIRES New Hires for EOG (2QFY07) – NLAI*

- **Migrate the DMSP OLS Archive to CLASS (2QFY07) – plan in place**

✓ *Relocate National Park Service Nightsky Team (2QFY07) – NLAI*

✓ *Need for 20+ Tb of Spinning Disk (1QFY07) – NLAI*

- **ADIC-API Needed (1QFY07) – plan in place**

NLAI = No Longer An Issue

Issues & Summary

Solar & Terrestrial Physics Division

- **All 1QFY09 milestones met & performance measures achieved**
- **Documented reductions in global gas flaring**
- **New dynasonde installed & tested at Boulder site**
- **NGS OPUS capabilities beta-tested at CORS-West**
- **Space environmental characterization for AFSPC**
- **NPOESS mitigation options study plan for OSTP**

Metrics (1QFY09)	
Papers published: 5	Reports: 9
Papers presented: 19	Professional Societies:17
Fellows: 1	Awards: None this quarter

QUESTIONS?